

TURTLE TRAILING:

A NEW TECHNIQUE FOR STUDYING THE LIFE HABITS OF CERTAIN TESTUDINATA

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(Figs. 278-284)

INTRODUCTION

In an effort to obtain detailed data on the general behavior and daily life of certain land turtles it became clearly evident that much could be accomplished if it were possible to make continuous observations on specific individuals. The well tested method of carving characters on the plastron, that has been in use for a long time by both the naturalist, for study, and the layman, for amusement, is sufficient for many purposes entailing long time observations but for others the information it supplies is too general and lacking in detail. In short, for the purposes in mind, it became desirable to find out what the turtles did between the observations that the carving method allowed of.

With these thoughts in mind an apparatus was devised which caused the individual turtle to unwittingly mark its own trail with a fine thread that unreeled from a spool as the turtle moved about. As will be subsequently shown, it is extremely doubtful if such an equipped turtle was aware of the presence of this object which caused him to record his activities that could only be otherwise obtained by a rather impractical sort of continuous observation. Although the work is still in somewhat of an experimental stage, its development this summer and the promise of useful returns that it holds has prompted this placing on record of the details of the technique.

The studies were carried on near Haskell, New Jersey, in 1926 at the camp of Mr. James E. Brooks of Glen Ridge, New Jersey, known as Camp Thomas Brooks. For the use of this camp and the adjoining land I am greatly indebted to the owner. I am also indebted to Mr. C. M. Breder, Jr., of the New York Aquarium, for his encouragement, criticism and the preparation of the accompanying diagrams.

USE OF THE METHOD

To make more clear the possible uses of this method of study, there are tabulated herewith a number of problems that might be attacked in this manner with a good expectancy of success.

1. Extent of the homing instinct.
2. Exact route taken to attain the "home" territory.
3. General wanderings on home territory. How differing from day to day as associated with season and weather.
4. Migrations, their extent and routes.
5. Activity during mating periods as compared with that at non-mating times.
6. Methods of search for nesting sites.
7. Significance of water in the lives of turtles.
8. Actions on a natural approach to various stimulæ, such as avoidance or search of sunny place.
9. Differences in the behavior of the sexes in any of these respects.

Many others might be tabulated, but the above will suffice to point out the manifold questions of biological significance that an intelligent and systematic application of this method should help to solve. It is to be especially noted that experiments in behavior of a laboratory nature do not duplicate those suggested above for field work, but rather, are complementary in nature.

THE APPARATUS

The only species worked with so far has been *Terrapene carolina* (Linnaeus). However the apparatus described below should work just as well on our other local terrestrial species *Clemmys insculpta* (Le Conte), and the possibility of applying it to *Gopherus polyphemus* (Daudin) or even larger forms with more elaborate equipment is fascinating.

Large spools of white basting thread holding 150 or 250 yards per spool and weighing about 30 grams were attached to the hind end of the carapace by means of iron wire as indicated in Fig. 278. A hole was bored through the flanging edge of the shell, by a small pen knife blade, to provide attachment. It was bored half way from each side to prevent splitting and undue enlargement and was placed so near to the edge that in time it would break through, releasing the trailer in case the animal came to the end of the line and was not retaken. The wire was hooked through this hole and passed through the spool so that the latter rotated freely on it as an axle. The bending and twisting of this wire is plainly indicated in Fig. 278. A guide was made of a lighter piece of wire attached

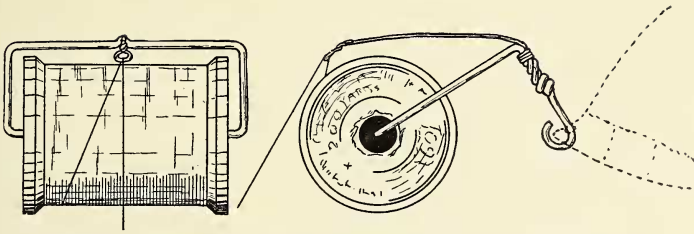


Fig. 278. Diagram of the construction of the trailer as used.

to the heavier wire where the latter was twisted together and provided with a loop, through which the thread passed. This loop was placed directly over the center of the spool so that the thread would play out freely and independently of the turtles activity, regardless of the abruptness of its turning.

The turtle thus provided was then released, the thread being tied to a small stake, and as it began to resume its life activities a complete record was laid out on the forest floor of the places it visited and often what it did until the end of the line was reached. Some time later, if the turtle was not recovered and provided with a new trailer, the thin edge of the shell should break and the device be dropped leaving a small notch as its only indication. For this reason as well as others symbols were always carved on the shell so that a later recovery would allow a continuation of observations as well as give such data as that method provides. Fig. 279 and 280 show turtles in the process of laying down trails.

The question might here be raised as to how much inconvenience this device causes a turtle. As the spools weigh about 30 grams and the average weight of a mature *Terrapene* is about 425 grams, the difference is so great that it can be of small significance, especially as two turtles of equal size will frequently differ much more than that amount in their own weights. The possible dragging effect it might have is also doubtless of no consequence for as a little observation will show such turtles are constantly forcing their way through tight places and continually being held back because of their shells catching on various objects. The resistance such a rolling spool might have is so slight in comparison that it is gravely doubted whether a turtle is at all conscious of the presence of the trailer. In this connection it should be pointed out that the trailer



Fig. 279. Turtle laying down a trail through rather open country.



Fig. 280. Turtle laying down a trail through rough country.

should be placed so as to clear any possible movements of the hind feet or tail and that the thread should be so passed through the guide that it unrolls in the proper direction of rotation for otherwise the spool in unwinding would be rotated against the direction it would naturally roll in which might produce some friction between it and the ground. Also it is important that white thread be used for ease in following the trail after it is laid, as any other color is seen with comparative difficulty afield. This is especially noticeable when passing under low bushes with dense foliage. There is, of course, always a possibility of the device being caught by some obstruction, but this, as is subsequently shown, is comparatively slight if the trailer is neatly made. It might also interfere with copulation but of this there is no data as yet.

APPLICATION OF THE METHOD

After the method was fairly satisfactorily worked out time was only sufficient to try it on four individuals. These were specifically marked on their plastrons T-16, T-18, T-20 and T-22. The first and third were given three runs each and the second and fourth one each making actually eight trails. In each case T-16 broke its thread due to an imperfection in the trailer as did T-22. This leaves a remainder of four complete and perfect trails. All are indicated on the accompanying sketch map, Fig. 281 which should be consulted in connection with the tabulation of the activities of these turtles given below:

- T-16 July 30th. Male. Taken at cabin 8:00 A.M. Plastron length 140 mm. Released without trailer at 9:10 A.M. Went directly to Post Brook and was seen there 11:30 A.M.
August 20th. Retaken about 1000 feet south-east of camp site. Released with trailer and started in direction from which it was brought, thread breaking in a short time.
August 21st. Retaken part way to spot where last seen. Released from same place and again started in same direction and broke thread.
September 2nd. Retaken in same general vicinity.
September 3rd. Released from same place and started in same general direction again breaking thread in each successive trial it moved progressively nearer to the brook.
- T-18 August 5th. Male. Taken in open woods almost north of camp site. Retained for 36 hours. Plastron length 140 mm.
August 6th. Released at cabin with a 300 foot spool at 6:30 P.M.

Very active and restless all time prior to release not retracting at any time. When released it made no stops but quickly and directly started away, Burrowed for the night.

- August 7th. Came to end of thread a few feet from where taken.
- T-20 August 27th. Female. Taken at cabin 8:15 A.M. Retained for 24 hours.
- August 29th. Released with trailer. Wandered about toward an open field, but refused to emerge into the bright sun.
- August 30th. Retaken at edge of woods a short distance from end of line. Returned to same place for a new start. Went to creek and entered it twice and headed in the opposite direction from yesterday. Dug in about 4:30 P.M.
- August 31st. Continued on way crossed creek. Retaken near end of line. Restarted as before. Followed yesterday's path closely but did not bathe and dug in at about 4:30 again near last night's lodging.
- September 1st. Continued on yesterday's trail and burrowed early.
- September 2nd. Crossed stream and returned and burrowed not far from where it burrowed the two previous nights.
- September 3rd. Wandered about in same territory and came to end of thread.
- T-22 September 25th. Male. Taken on hillside south east of cabin and across brook from it.
- September 26th. Released with trailer at cabin. Headed straight in direction of capture and burrowed early.
- September 27th. String broken but pointing to position of capture.

A consideration of the data here presented when compared with the map, Fig. 281, reveals some rather interesting conditions. T-16, T-18 and T-22 all show a direct tendency to go to the point from which they were picked up. As the earlier dates of T-16 show it was apparently at all times on its home territory but nevertheless desired to get back to where it had been last taken from. T-22 would seem to have its home lands across the brook. The trail of T-18 is the most interesting in that it is so complete and perfect. Here an active, strong and apparently fearless specimen sought out and found his "home" territory with great expedition. It was of extreme interest to note that he took the most direct route, avoiding trees and rocks of large size and still continually gaining altitude. That is, he followed the crests of small ridges and carefully avoided gullies. Only in one place, as shown on the map did he descend into one. This gully was so long that a detour would have been less efficient than the descent he made into its shallow depth. It is also noteworthy that he apparently did not travel by dark as

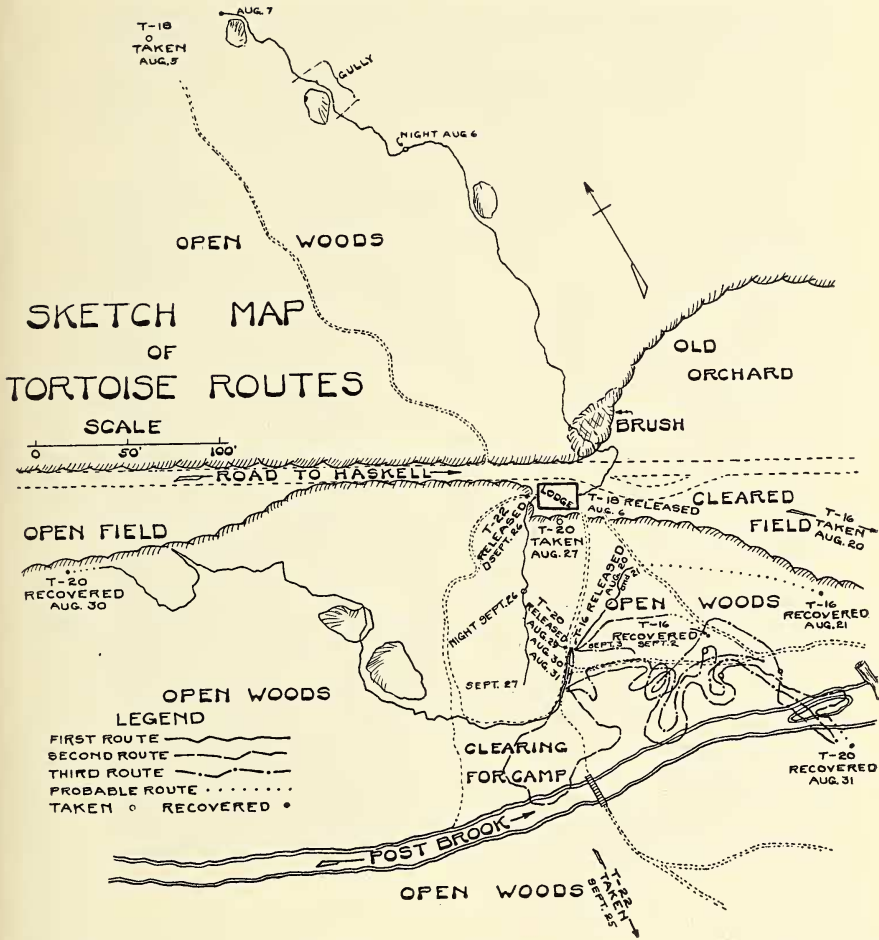


Fig. 281. Freehand sketch-map of Camp Thomas Brooks and environs showing paths taken by the turtles studied as indicated by their trails. The important points are marked and the significant dates indicated.

the thread went underground in a burrow exactly as did others which we know buried themselves for the night. He pushed right on through not backing out of the hole as might be expected. However, this had apparently little to do with the direction he was going in for in all cases they emerged from their burrows in this same manner. This in itself is interesting and would not have been sus-

pected if it had not been for the application of the present method. There is every reason to conclude that the sense of direction is well developed in these turtles and that in an effort to attain the desired location they pick the geometrically shortest route in respect to vertical movements and the avoidance of obstacles as well as the proper horizontal angle.

In the case of T-20 we apparently have a turtle already on "home" territory. Her first trail is much more rambling and as that day was especially warm and sunny it is interesting to contemplate her edging along the hot and dry field and her refusal to leave the shade of the woods. It is noteworthy also that her intelligence was not sufficiently great to prevent her from making a second attempt to go in the direction of the field that so recently turned her back or she may have been edging along under some comparatively strong motive to cross that field. It would be interesting to know what urged her to move in this direction. The second trail on an equally hot day started in the same direction as the first but finally carried her down to the water where two emersions were made before digging in for the night which was done well before sundown. Fig. 282 shows the first part of these two trails where they still ran together along the path. Compare with Fig. 281. The photo was taken looking up the path from the camp clearing. On coming out the next day after sun-up she entered and this time crossed the creek. On retaking and release from the old starting point an almost identical route was covered except that bathing was omitted and the path somewhat shortened. It cannot but remind one of the shortening of routes so common in experiments on animal psychology. After spending another night close to where the last one was spent she continued on her journey again crossing the creek and one might think to continue on her journey on the other side that was interrupted when she was brought back to her starting point. Here we might almost imagine that some objective was in view as is often seen in experiments on behavior in the interruption of animal acts that she had no better discrimination than to repeat nearly all the acts preliminary to attaining this point whether necessary or not. However, this hardly seems to be the case, for on attaining the point at which she was recovered yesterday she doubled back and returned close to the place that the preceding nights were spent before coming to the end of her line. All this is simply

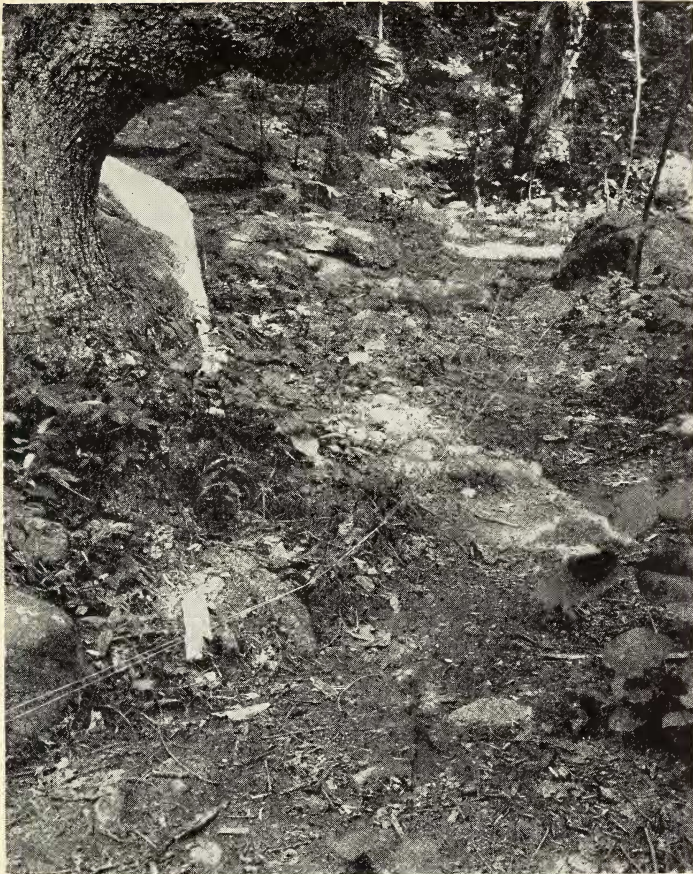


Fig. 282. The start of the first and second trail of T-20.

interpreted to mean that she was on her "home" land and not going any place in particular but wandering around in search of food or what not. It is inferred from these considerations of the preceding data that T-16 has its center of activity somewhat to the south-east of camp and north of the brook, T-18 across the road from camp on the hillside, T-20 between the camp and the brook and T-22 across the brook from the camp at some distance. Continued studies another year should give further data of this nature, such as the normal extent of their range of territory, how close they adhere to it from season to season, and so on. There is a possibility that a differential

behavior of the sexes complicates this for it so happens that the one on "home" territory was a female while the other three were all males. It is also to be noted that on Sept. 2d when male T-16 was recovered for the last time and female T-20 had just emerged from her burrow close by that they were found craning their necks and apparently taking notice of each other.

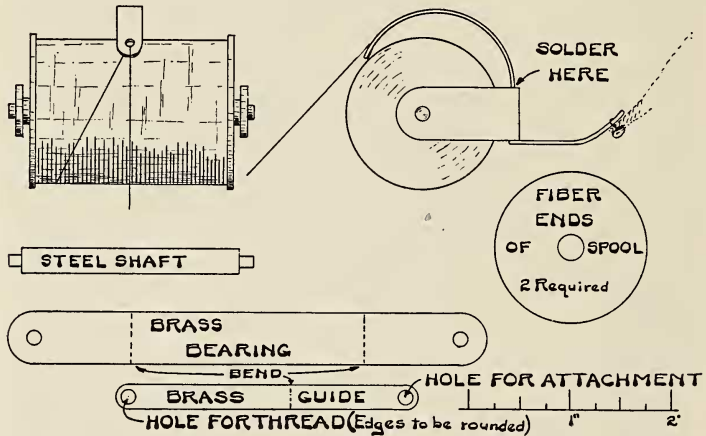


Fig. 283. Diagram of the construction of the trailer as proposed.

PROPOSED METHODS

The chief faults with the present method seem to be that the spools do not carry enough thread and in order to renew the spool it is necessary to take the apparatus apart and that it is a rather crude device. Work is now in progress looking forward to another season on the construction of more refined trailers. These are being built according to the plans given in Fig. 283 designed in collaboration with Mr. Breder.

Supplanting the spool of large diameter is to be a bobbin of small diameter on which the contents of several spools may be wound. This may be done rapidly and effectively by placing the end of the bobbin in the jaws of a breast drill or other similar device. Also the thread may be tied to the bobbin so as to hold the turtle at the end of the line. It is remarkable how often ordinary basting thread will succeed in tethering such a turtle.

As indicated in the sketch the bobbin is held in place between the spring fingers of the bearing clip. Thus a new spool may be

inserted in a moment by simply spreading it apart. It is believed that much greater satisfaction will be had with this improved device.

OTHER APPLICATIONS OF THE METHOD

It seems likely that this method, with various modifications might be applied with success to other animals that spend most of their time on the ground. While it is almost impossible to devise an apparatus small or light enough for an anuran to carry, in connection with work on tagged frogs in progress at the same time, a little device of a similar nature shown by Fig. 284-A was tried. Of course, the length of line was very slight as compared with that of the turtles and the devices no doubt interfered with the frogs activity although some data of interest in a corollary way to the tagging operations were obtained.

Two *Bufo fowleri* Garman released at the cabin, a male B-90 and a female B-89 made very different tracks. The former moved straight away in a single direction, while the latter zigzagged about as indicated in Fig. 284-B. Without becoming facetious, there may be some differences in the normal behavior of the sexes in this regard. Two trials of a similar nature of a male *Rana palustris* Le Conte, B-92, 1 and 2, showed that it was seemingly not trying to go in any given direction but moved about much more erratically than either of the toads and both times finally came to rest under the cabin. Of course, we already know that this species is more active than the comparatively stolid toad. See Fig. 284-B.

At the Station for the study of insects at Palisades Interstate Park through the courtesy of its director, Dr. Frank E. Lutz, of the American Museum of Natural History, Mr. Breder so equipped four male *Bufo fowleri* during the breeding season B-I, B-T, B-AH, B-AI in one evening. The first two of them had previously returned to their home locality and had been retaken and two were removed from the same place for the first time. It is to be noted that the two that were there for the first time moved much less directly than the two that were apparently on their second journey, and that the first two went to one side of the cabin furthest away from their home site while the other two went more directly toward it. This may have considerable or no significance but it will be discussed in its more proper place in a paper on the results of the tagging of anurans. See Fig. 284-C.

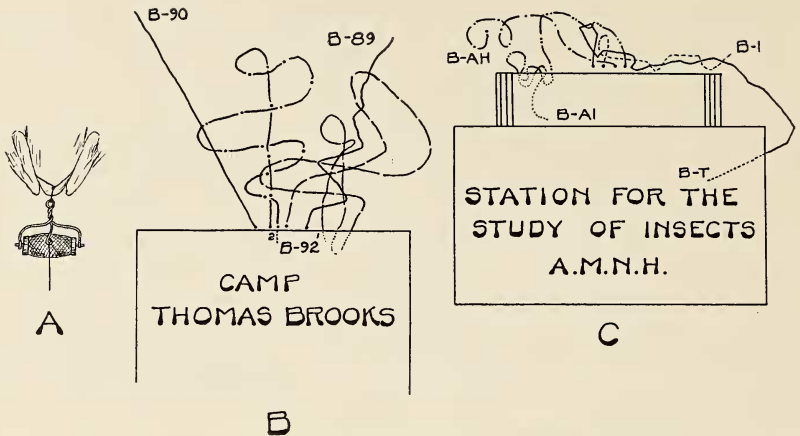


Fig. 284. A—Sketch of a frog trailer attached; B—Routes of *Bufo fowleri* B-89 and 90 and one *Rana palustris* B-92 (two routes 1 and 2) as indicated by trailer at Camp Thomas Brooks; C—Routes of four male *Bufo fowleri* B-AH, B-AI, B-I and B-T as indicated by trailer at the Station for the study of insects.

While it is obvious that this method is primarily best suited to animals of a ponderous sort that are strictly terrestrial in habit, speculation and a little thought might lead to some other device that could cause lighter and more agile animals to record their comings and goings without interfering seriously with their normal life.

CONCLUSIONS

Whilst, as previously pointed out, the work is still in an early stage, the following somewhat tentative conclusions are offered as indicative of the data that may be amassed by this method.

1. *Terrapene carolina* has a well developed sense of direction.
2. It takes the most direct route in regard to both the horizontal angle and the vertical and uses discrimination in a choice of paths in avoiding obstacles while attempting to reach a desired location.
3. Each individual has apparently an area of rather circumscribed dimensions which it traverses and which it will attempt to reach if removed a short distance therefrom.
4. It wanders about rather at random when on its "home" territory.

5. It burrows in leaf mold for the night and is most active just after sunrise and before sunset.
6. In emerging from a burrow it proceeds to "plow" through the soft soil, not backing out in any case (5 in all).
7. The device herewith described is not of an encumbering nature and interferes little, if any, in the activity of the animal.